2.1 Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations and Review of Integrated Scenario Development and Application
Expert Review Collation and Responses to Comments
February 2 – March 7, 2005

Reviewers

Edison Electric Institute
Eric Holdsworth
William L. Fang
Edison Electric Institute
701 Pennsylvania Avenue, N.W.
Washington, D.C. 20006
Phone(s): (202) 508-5103
(202) 508-5617
E-mail(s): eholdsworth@eei.org
bfang@eei.org
Area of Expertise: Climate change issues relating to scientific assessment concerns

Nathan E. Hultman
Georgetown University
ICC 305-Q, 37th & O Streets NW, Washington DC 20057
Phone: 202-687-7284
Fax: 202-687-5528
E-mail(s): neh3@georgetown.edu
Area of Expertise: Carbon sinks, international climate policy, science-policy interface

Russell Jones
Policy Analysis Department
American Petroleum Institute
1220 L Street NW
Washington, DC 20005
Phone: 202-682-8545
Fax: 202-682-8408
E-mail: jonesr@api.org

Michael MacCracken
Climate Institute
1785 Massachusetts Ave., NW,
Suite 100
Washington DC 20036
Phone: 301-564-4255
E-mail: mmaccrac@comcast.net
Areas of expertise: Climate change, climate impacts, and assessment

William F. O'Keefe
George C. Marshall Institute
1625 K Street, NW
Suite 1050
Washington, DC 20006
Phone: (202) 296-9655
Fax: (202) 296-9714
E-mail: okeefe@marshall.org
Area of Expertise: Climate change policy

Donald Pearlman
The Climate Council
Suite 700
2550 M Street NW
Washington, DC 20037-1350
Tel: 202 457 6501
Fax: 202 457 6315
dpearlman@pattonboggs.com

James S. Wang, Ph.D.
Scientist
Climate and Air Program
Environmental Defense
257 Park Avenue South
New York, NY 10010
Tel: 1-212-616-1339
Fax: 1-212-254-7408
jwang@environmentaldefense.org

General Comments

Edison Electric Institute, Holdsworth and Fang

According to the draft, the purposes of this Prospectus are two-fold: First, to update scenarios of greenhouse gas (GHG) "emissions and atmospheric concentrations," which is designated as "Part A," and second, to review "integrated scenario development and application," which is designated as "Part B." In the case of Part A, the stated objective is to "use integrated assessment models as the formulation for a small group of new and updated global emissions scenarios leading to long-term stabilization" of GHG "concentrations," with "[f]our stabilization levels" ranging from "450 ppm through 750 ppm" to be considered as a "basis" for the "stabilization scenarios." The final product of Part A is to be a "data set that includes pertinent numerical information for each scenario," including "emissions trajectories."

For Part B, the draft states that the Product "will review and evaluate how the science and stakeholder communities define, develop, implement, and communicate scenarios in the global climate change context, and how this process might be enhanced or improved." This effort is to "include a review of past scenario development and application efforts."

We question why the CCSP believes it wise to carry out Part A and provide "new and updated" global stabilization scenarios by the U.S. before the Part B effort has been undertaken and completed. To our knowledge, the Intergovernmental Panel on Climate Change (IPCC), despite considerable recent criticisms of its scenarios, does not plan to replace or even revise them for the Fourth Assessment Report, but apparently will consider new scenarios for the Fifth Assessment Report once authorized sometime after 2007. Yet the draft states that Part A, together with Part B, will "enhance IPCC efforts" to produce scenarios and conduct scenario analysis." At the 10th meeting of the Conference of the Parties in Buenos Aires, Under Secretary of State Paula Dobriansky at a December 16, 2004, press conference said that the U.S. "has not favored mandatory" climate "steps, targets and timetables," that "it is essential to have a robust program and approach," that the U.S. is "committed to the ultimate objective" of the Framework Convention on Climate Change, and "[t]oward that end, our programs are geared toward effecting and addressing greenhouse gas emissions now, in the near-term, in the mid-term and the long-term." She added that "the very essence" of the U.S. approach is one that places a premium on the "development and the deployment of transformational technologies."

We did not understand from the Under Secretary's remarks in support of the "ultimate objective" of Article 2 of the FCCC that the U.S. was on the verge of developing "new" global stabilization scenarios for the four levels, particularly in advance of the Part B efforts, the "intent" of which is "to inform preparation and application of future scenarios by the CCSP, the IPCC, the CCTP, and other global change research and assessment organizations." Proposed CCSP development of scenarios prior to learning the results of Part B seems very premature at best.

Response: Generating scenarios is not a once-and-for-all activity, but must be repeatedly iterated and updated as knowledge advances and conditions change. Consequently, Part A can contribute to advanced understanding of emission trends and associated economic and technological issues without needing to await completion of Part B.

In addition, we do not understand what is contemplated by the draft Prospectus in saying that Part A will use modeling "as the foundation" for "updated" scenarios. To our knowledge, the U.S. has not yet developed "global emissions scenarios leading to long-term stabilization" of GHG concentrations. If our understanding is accurate, there is nothing to update. The draft needs clarification in this regard.

Response: The prospectus has been modified appropriately.

Finally, the draft states that both Parts "will be coordinated with each other" and other CCSP products and that they will "enhance ongoing international efforts to produce scenarios and conduct scenario analysis by such entities as the Intergovernmental Panel on Climate Change" and the U.S. Climate Change Technology Program. However, it is unclear how this coordination is to occur, as it is not evident from the draft Prospectus.

For example, section 5 on "**Drafting**" shows the basis for the drafts under each Part is quite different and strongly suggests that the drafting will be carried out independently. Clearly, section 6 on **"Review"** provides no evidence of coordination and, in fact, states that both Parts "will be reviewed independently." In the case of draft section 7 on **"Related Activities,"** the only possible evidence of coordination is the statement that "[t]o the extent possible, any interactions between Part A and Part B will be exploited," without giving any indication or direction as to how and when that will happen. Given the subject matter and purpose of Part B, strong coordination must, at a minimum, be a part of this joint effort for a 2.1 Product and that the prospectus should clearly show how and when it will be integrated in development of the Product.

Response: The discussion of coordination between the two products has been clarified in the prospectus. Communication and interaction between the two product teams will take place primarily through cross-participation in the Part A and Part B, along with cross-participation in meetings, conference calls, and other venues for planning and producing the two products.

Hultman, Georgetown University
This prospectus gives guidelines on which elements should be harmonized across different modeling groups, highlighting specifically (1) stabilization levels and (2) GHGs to be included. However, one of the more important aspects of translating from atmospheric insult to human or ecological impact is the expected radiative forcing under different scenarios. An illustrative (but unrealistic) example is the world with high GHG and zero particulate pollution which has a higher forcing than a similar world with high GHG and high aerosol. This example indicates that much of the danger of climate change—what we really care about—depends not simply on final concentrations but also on the resulting net forcing. The current prospectus ignores this crucial element and, therefore, the relevance of the results is less solid than the might otherwise be. Including specific treatment of radiative forcing would be a feasible and useful goal, both for the scientific and policy audiences.

Response: As stated in the prospectus, the stabilization scenarios will be based on a multi-gas approach with radiative forcing used to define stabilization. This multi-gas approach will include CO_2, CH_4, N_2O, CFCs, HFCs, and SF_6. This suite of gases forms the basis for the United States greenhouse gas intensity reduction policy announced by the President on February 14th, 2002 (see the Addendum to the Global Climate Change Policy Book at http://www.whitehouse.gov/news/releases/2002/02/addendum.pdf)

The four alternative stabilization levels will not include direct or indirect radiative forcing from substances such as aerosols, aerosol precursors, and tropospheric ozone precursors, for the additional reasons of uncertainty in the state of scientific understanding regarding their climatic effects, the importance of regional and short-term detail in looking at these substances, and associated limitations in the ability of many integrated assessment models to represent their emissions and climatic effects with a sufficient level of integrity and sophistication.

At the same time, some integrated assessment models can represent the emissions of these substances (to be distinguished from climatic effects). To the extent that models carry along information on these emissions, such information may be made available by the individual modeling teams.

Jones, American Petroleum Institute

Lack of Discussion of Baseline or Reference Case Scenarios

The Prospectus does not mention "baseline" or "reference case" scenarios (hereafter referred to as reference cases) which would characterize the world in which a stabilization target is not met. However, assessing "economic implications" as discussed on page 2, lines 27-28 requires a comparison of two cases, a stabilization case and the reference case. The Prospectus should clearly state the need for fully documented reference cases and indicate whether each modeling group will create their own reference case or cases or whether there will be a single (set of) reference case(s) for all modeling groups. Suggestions for reference case text are made below.

Response: The prospectus has been modified to explicitly state that the corresponding reference cases will be reported along with each set of stabilization scenarios.

If a reference case is going to assume that no new climate policies beyond those that exist today are undertaken over the next 100 years, that should be clearly stated.

Response: The approach to climate policies in the reference case and the stabilization cases is now explicitly discussed in the prospectus. All scenarios and associated reference cases will include the continuation of current government programs both within and outside the U.S., focused explicitly on the global climate. This includes the United States' greenhouse gas intensity goal through 2012 and the first commitment period of the Kyoto Protocol, which also ends in 2012. The reference case will assume no policies focused explicitly on the global climate beyond these near-term policies.

Lack of Identified Policies to Achieve Stabilization Scenarios

The Prospectus does not require that the modeling groups specify what policies are used to achieve the stabilization scenarios. Many policies (e.g., carbon taxes, tradable permits, technology or performance mandates like CAFE) all have varying economic impacts beyond their narrow greenhouse gas (GHG) emission impacts. Unless the policies used to achieve stabilization are carefully identified and characterized, there is no basis to even ask for "economic implications" as specified on page 2, lines 27-28.

Response: The approach to climate policies in the reference case and the stabilization cases is now explicitly discussed in the prospectus. All scenarios and associated reference cases will include the continuation the United States' greenhouse gas intensity goal through 2012 and the first commitment period of the Kyoto Protocol, which also ends in 2012. In the stabilization scenarios, these near-term policies will be followed by a notional policy, in which all nations of the world participate in emissions reductions and the marginal costs of emissions reductions are equalized across countries and regions.

MacCracken, Climate Institute
The set of proposed lead authors for the two parts of the report appear to be of the very highest competence and quality.

Response: Comment noted.

Pearlman, The Climate Council
We note from Section 4 of the Draft Prospectus ("Stakeholder Interactions") that the stakeholder input solicited through the public comment period for the aforesaid Draft Prospectus and the public comment period for the draft final reports "may be enhanced by direct requests for input, during the public comment periods, from a set of stake-holders identified by the lead and supporting agencies" and that, "[i]n addition, individual authors for Parts A and B will participate in a range of scenario-relevant conferences, meetings, or other forums, at which the authors will solicit feedback, both formally and informally." If I may be of assistance in either respect, please do not hesitate to inquire as to appropriate arrangements. (Note from cover letter)

General Comment: The Part A product is "a small group of new and updated global emissions scenarios leading to long-term stabilization of greenhouse gas concentrations" (Draft Prospectus, p. l), "defined in terms of the radiative forcing resulting from the long-term combined effects" of multiple, specified greenhouse gases. (Draft Prospectus, p. 2). Although the Climate Change Science Program's (CCSP) Strategic Plan does not appear explicitly to have prescribed development of these "stabilization scenarios," they arguably fall within one or more of the broadly worded "priorities" sprinkled throughout the Plan. *E.g.*, "Updating scenarios of greenhouse gas emissions and concentrations, in collaboration with the Climate Change Technology Program (CCTP); review of integrated scenario development and application," under "CCSP Topics For Integrated Synthesis and Assessment Products," in *Strategic Plan for the U.S. Climate Change Science Program*, p. 115, Box 11-2 (July 2003).

Although this General Comment questions the wisdom of undertaking development of these stabilization scenarios *in accordance with the proposed schedule for publication* of the "[f]inal product," August 2006 (Draft Prospectus, p. 7), raising these issues must not be misinterpreted as opposition to multi-gas stabilization scenarios or, necessarily, to stabilization defined in terms of radiative forcing. As and when there is an acceptable level of resolution of the issues discussed here, it will help to have the benefit of information from new multi-gas stabilization scenarios. Preliminary indications from current studies indicate that the costs of reducing emissions in multi-gas stabilization scenarios are substantially less than strategies focused only on CO_2 reductions.[1]

[1] This is evident from various presentations at the IPCC Expert Meeting on Emission Scenarios (Washington, D.C. January 2005). *E.g.*, D. van Vuuren, "Multigas scenarios to stabilize radiative forcing," overhead No. 29; R. Richels, "Developing Stabilization Targets," overheads Nos. 17, 20-22; K. Riahi, "Present and expected research activities (EMF-21) and gaps in knowledge in stabilization/emission scenarios," overhead No. 23.

Nevertheless, it is questionable whether the overall objective of the CCSP is well served by publication of the CCSP stabilization scenarios before there is significant progress in overcoming the problems and issues summarized below. The CCSP must confront the challenging question of how much "added value" will be gained by the *scheduled* development of new scenarios over and above what might be learned from the multi-gas scenarios considered in the presentations referred to in Note 1 of these Comments or the CO_2 stabilization scenarios assessed by the IPCC in its Third Assessment Report, Houghton, et al., *Climate Change 2001: The Scientific Basis* (hereinafter referred to as *TAR-Science*), pp. 75-76, 224 (2001).[2]

Issues to be considered, regarding *when* to develop new stabilization scenarios, include:

First: Have there have been sufficient scientific advances in overcoming the IPCC's assessments of the"[*u*]*ncertainties in converting emissions to concentrations*," *TAR-Science*, p. 755 (emphasis in original)? These uncertainties attend both CO_2-only[3] and multi-gas[4] scenarios. Stabilization scenarios involve methodologies similar to those used in estimating atmospheric concentrations resulting from emissions scenarios, *TAR-Science*, p. 224, except, of course, that the process is inverse; emissions levels and their time paths are deduced for prescribed atmospheric concentrations. It necessarily follows that stabilization scenarios suffer from the same uncertainties that attend projections of concentrations driven by emissions scenarios.[5]

Second: Bearing in mind that the proposed multi-gas stabilization scenarios will be "defined in terms of the[ir] radiative forcing" (Draft Prospectus, p. 2), have there been sufficient scientific advances in overcoming the IPCC's assessments of the

---

[2] Even though the proposed stabilization scenarios involve multi-gas emissions, separate CO_2 scenarios must be constructed to enable cost comparisons between multi-gas and CO_2-only strategies; and, in any event, CO_2 will constitute the largest part of the multi-gas scenarios.

[3] "These uncertainties reflect incomplete understanding of climate sensitivity and the carbon cycle. They substantially limit our current ability to make quantitative predictions about the future consequences of a given emissions trajectory." *TAR-Science*, p. 223. The effect of the uncertainty of climate sensitivity from 1.5 to 4.5°C, as calculated by the Bern-CC model with respect to the IPCC's IS92a emissions scenario, appears to be more than 100 ppm by 2100. *TAR-Science*, p. 220, Figure 3.11(b). In addition to uncertainty about climate sensitivity, "[t]here is considerable uncertainty in projections of future CO_2 concentration, because of uncertainty about the effects of climate change on the processes determining ocean and land uptake of CO_2." *TAR-Science*, p. 224.

[4] "It is uncertain how a given emissions path converts into atmospheric concentrations of the *various radiatively active gases or aerosols*. This is because of uncertainties in processes relating to the carbon cycle, to atmospheric trace gas chemistry and to aerosol physics (see Chapters 3, 4 and 5)." *TAR-Science*, p. 755 (emphasis added).

[5] After noting the wide projected range of CO_2 concentrations in 2100 resulting from the six principal SRES emissions scenarios (550 to 970 ppm in one model; 540 to 960 ppm in another model), the IPCC observed that "[v]ariations in climate sensitivity and ocean and terrestrial model responses add at least -10 to +30% uncertainty to these values, *and to the emissions implied by the stabilization scenarios*." *TAR-Science*, p. 186 (emphasis added).

"[*u*]*ncertainties in converting concentrations to radiative forcing*" *TAR-Science*, p. 755 (emphasis in original)? "Even when presented with a given greenhouse gas concentration scenario, there are considerable uncertainties in the radiative forcing changes, especially aerosol forcing, associated with changes in atmospheric concentrations." *Ibid.*[6]

Third: Development of multi-gas stabilization scenarios expressed in terms of radiative forcing requires further consideration of the serious methodological issues concerning use of Global Warming Potentials (GWPs) to estimate the radiative forcing of non-CO_2 gases. They are: (1) an important purpose of the proposed stabilization scenarios, comparison of multi-gas and CO_2-only mitigation strategies, is not well served by the fact that GWPs are intended to reflect only physical reality, not abatement costs; and, perhaps more importantly, (2) they are determined over arbitrarily selected time periods. See D. van Vuuren, "Multigas scenarios to stabilize radiative forcing," overhead No. 30 of presentation at the IPCC Expert Meeting on Emission Scenarios (Washington, D.C. January 2005).[7] The Draft Prospectus gives no indication of whether these issues have been considered, or the state of the science bearing on their resolution for purposes of multi-gas stabilization scenarios, or assessment of the pros and cons for using GWPs, including alternative methodologies for dealing with stabilization analyses.

Fourth: A CCSP report of the proposed stabilization scenarios would have to contain "[e]xplicit treatment of [the] uncertainties" regarding conversion of emissions to concentrations, conversion of concentrations to radiative forcing, and use of GWPs in the proposed stabilization scenarios.[8] See CCSP, *Strategic Plan for the U.S. Climate Change Science Program*, p. 111 (July 2003)(CCSP has "responsibility to define the applicability limits imposed on various projections and other analyses, as related to uncertainties in the underlying data and analysis methods"). Furthermore, it appears that the underlying

---

[6] The IPCC says that the level of scientific understanding (LOSU) with respect to the direct radiative forcing for sulfate aerosols is low, while for the direct radiative forcing for biomass burning, fossil fuel organic carbon, fossil fuel black carbon, and mineral dust the LOSU is "very low." The LOSU for the indirect radiative effect of anthropogenic sulfate and carbonaceous aerosols (which could be as large or larger than their direct forcing effects) is described as "very low." *TAR-Science*, p. 351; see also Summary for Policymakers, Figure 3.

[7] The GWPs for methane and nitrous oxide range from 56 to 21 and from 280 to 310, respectively, depending on whether the chosen time horizon is 20 or 100 years. See R. Richels, "Developing Stabilization Targets," overhead No. 12 of presentation at the IPCC Expert Meeting on Emission Scenarios (Washington, D.C. January 2005). Furthermore, CO_2 is the reference gas normally used for calculating GWPs, but, as the IPCC has observed: "The atmospheric response time of CO_2 is subject to substantial scientific uncertainties, due to limitations in our knowledge of key processes including its uptake by the biosphere and ocean. When CO_2 is used as the reference, the numerical values of the GWPs of all greenhouse gases can change substantially as research improves the understanding of the removal processes of CO_2." *TAR-Science*, p. 386.

[8] The EMF-21 work on analysis of multi-gas mitigation strategies reveals a wide range of carbon permit prices, and they reflect uncertainties of, among other things, model methodology and model parameterization. K. Riahi, "Present and expected research activities (EMF-21) and gaps in knowledge in stabilization/emission scenarios," overhead No. 23 of presentation at the IPCC Expert Meeting on Emission Scenarios (Washington, D.C. January 2005).

science pertinent to these uncertainties either will be or could be addressed in the broadly characterized work contemplated in Chapters 3, 6, 7, 10, and 11 of the CCSP Strategic Plan. Relating the current state of such work to the aforesaid three clusters of uncertainties is required by CCSP guidelines, which contemplate "a 'lessons learned' approach, building on the ongoing CCSP analyses." CCSP "Guidelines for Producing CCSP Synthesis and Assessment Products," p. 1 (December 2004).

It does not make sense to go to the time, trouble, and expense of *actually developing* the stabilization scenarios and *then* disclosing the treatment of these uncertainties and inviting public comments on the draft scenarios, which have been produced regardless of the uncertainties, rather than issuing a revised Draft Prospectus that specifically invites comments on the three clusters of uncertainties, so that the CCSP can benefit from reviewers' inputs *before* deciding on a schedule for the scenarios' development.

Response: (1& 2) There are multiple uncertainties in scenario generation, including those mentioned above and others, but CCSP believes that this product will be useful regardless of the uncertainties. A primary purpose of scenarios is to facilitate understanding in situations of uncertainty. We note that these scenarios do not include aerosol forcings and their attendant uncertainties. Radiative forcings are restricted to CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 gases for which uncertainties are less severe than is the case for aerosols and dark particles.

(3) GWPs will not be used in the CCSP scenarios. These scenarios will be generated by models that employ explicit representations of the atmosphere. Radiative forcing will be calculated explicitly as the sum of the radiative forcing from the individual constituents.

(4) The prospectus has been modified appropriately to make clear that one section of the final report will discuss the uncertainties that surround the development of stabilization scenarios. However, no attempt will be made to conduct a formal uncertainty analysis.

Wang, Environmental Defense

First General: There's no mention of business-as-usual (BAU) emissions trajectories. That's a useful concept, especially in formulating policies; granted, it can be difficult to estimate what exactly BAU would be. I suggest that the prospectus include a proposal to construct BAU trajectories as well as alternative trajectories.

Response: The prospectus has been modified to explicitly state that the corresponding reference cases will be reported along with each set of stabilization scenarios.

Second General Comment: There's no discussion of carbon sinks and deforestation, and of how different levels of carbon sequestration and/or deforestation would affect CO_2 trajectories.

Response: Assumptions regarding land use and land use change as both GHG sources and sinks will be presented and discussed in the final report. Because models have

varying capabilities to explicitly consider land use and land use change, however, such consideration will vary across models.

Third General Comment: The prospectus could explicitly propose an analysis of the efficacy of reducing emissions of short-lived pollutants, such as methane, ozone precursors, and soot, in the short-term. In other words, an examination of the effects of focusing on short-lived species rather than CO_2 in the near term.

Response: Without a long-term perspective, it will not be possible to understand the full implications of stabilization for greenhouse gas concentrations. This is particularly true of CO_2, which must be stabilized over many centuries. Consequently, the foundation of the CCSP scenarios will be long-term stabilization. The participating modeling teams will be directed to develop approaches to long-term stabilization independently, including the treatment of any short-lived substances included in calculation of radiative forcing. Some models may call for near-term reductions in the emissions from these substances, while others push back substantial reductions. The implications of stabilization for those substances not included in the radiative forcing calculations will not be explicitly considered in the scenarios. However, some models may carry along and make available emissions information on some of these substances. In this case, the emissions trajectories of these substances may be indirectly affected by reductions made in substances considered in meeting the four alternative radiative forcing levels.

Specific Comments

Page 1, Line 16: In addition to noting that "[s]cenarios are not predictions," the Prospectus should state that, "as required by the CCSP, the final product explicitly will discuss the uncertainties concerning the stabilization scenarios." See CCSP, *Strategic Plan for the U.S. Climate Change Science Program*, p. 111 (July 2003).
Donald H. Pearlman -- The Climate Council

Response: The prospectus has been modified appropriately to make clear that uncertainty will be discussed in the final report.

Page 1, Line 29: 1.1 Part A: Updated Scenarios of Greenhouse Gas Emission and Atmospheric Concentrations
Part A of this project proposes to generate four emissions scenarios leading to long-term stabilization of atmospheric CO_2 concentration at levels in the range of 450-750 ppm. It then proposes to make judgments about the dominant technologies or fuels consistent with stabilization at the four alternate levels and to assess the possible economic implications of meeting these four levels. The Marshall Institute questions whether these objectives are achievable or useful.

It is well-established by past work on stabilization pathways that any reasonable path to the stabilization of atmospheric concentrations of greenhouse gases will extend well beyond 2100. It is also well established that the controlling factor is the cumulative emissions of long-lived greenhouse gases, and that there are a large number of emissions pathways that can achieve the same cumulative emissions over the time needed to reach

stabilization at any given concentration level. Past work in this area (Wigley, Richels and Edmonds, 1996; IPCC, 1996) has been limited to describing possible paths to stabilization. Others have used these pathways to examine the emissions reductions that would be necessary to meet those curves and speculated about the technology that might be have to be used (Dooley, 2001; Hoffert, et al, 1998).

Cumulative emissions will be determined by the rates of population growth, economic growth, and technological innovation, none of which can be forecast with any accuracy for more than 20-50 years into the future. Any scenario will be limited by the range of experience in these three areas, and experience indicates that projections more than 20-50 years into the future are so assumption-driven that they can only serve to confuse. See, for example, Castles and Henderson's critique of the IPCC Special Report on Emission Scenarios (Castles and Henderson, 2003; Henderson, 2004).

The prospectus states

> The updated scenarios are intended for technology planners, such as the CCTP, who are interested in the role of technology in stabilization; other decisionmakers or analysts interested in the overall results and implications of the scenarios or requiring scenario data for further analysis; and climate modelers who might use emissions trajectories as input of climate modeling.

Let us examine each of these potential audiences, starting with technology planners. It is obvious that achieving the deep reductions in emissions needed to achieve stabilization will require the wide-spread application a broad range of technologies. Technology planners need to understand the emissions reduction and cost potential of various technologies as much as 50 years into the future, which is the replacement interval for energy system technology. Given the uncertainty of scenario projections for longer time periods, and the likelihood that technologies not under consideration now will be important then, we see no value to technology planners from scenarios that extend out for centuries. Other decisionmakers are in a similar position: what is the value of highly uncertain information for a time period that is well beyond the time that their decisions will have impact? While climate modelers need emission trajectories as input to their models, this information can be developed in a much simpler manner than the emissions scenario exercise envisioned in this prospectus.

We strongly urge CCSP to reconsider the goals of this project and to focus on the timeframe that is reasonably predictable, which is 20-50 years into the future.
O'Keefe, Marshall Institute

Response: To understand the implications of stabilization for CO_2 emissions, it is important to look out far enough to capture the approach of CO_2 concentrations toward stabilization. A 20 to 50 year horizon is not sufficient to capture this dynamic, so the study period for the CCSP scenarios will be approximately 100 years, from the present through 2100. As the commenter points out, there is substantial uncertainty surrounding the characteristics of future technologies. The CCSP believes that this product will be valuable regardless of uncertainty surrounding future technologies.

Page 1, line 42: Change: “for each scenario,”
to read: “for the reference case(s) and for each scenario for each of the participating modeling teams,”

Explanation: Without comparable data for the reference case(s) in the data set, no comparisons can be made between the reference case and a stabilization scenario, and no useful assessments can be made about the pluses/minuses of different stabilization scenarios. Without data for each modeling team identified individually, it is not clear what the data set would contain.
Russell Jones, American Petroleum Institute

Response: The prospectus has been modified to explicitly state that the corresponding reference cases will be reported along with each set of stabilization scenarios.

Page 1, line 43: Change: “and population trajectories;”
to read: “population trajectories, real economic output (specified whether calculated in purchasing power parity or money exchange rates terms), and reports data for each major country/region contained in the integrated assessment model, for specified dates (e.g., 1990, 2000, 2010, 2025, 2050, 2075, 2100, and 2150);”

Explanation: Without economic activity information in the data set, no economic implications can be assessed. Without specific information on where emissions are occurring in the reference case and stabilization scenarios, it will not be possible to evaluate the relative advantage of different strategies for reaching a given stabilization scenario, especially if technologies for limiting emissions vary between geographic regions. The CCSP should specify dates for data reporting. The suggested dates are simply commonly used reference points.
Russell Jones, American Petroleum Institute

Response: The need to provide information that will effectively describe the scenarios is noted. The cross-model information set will include information that provides a meaningful characterization of the scenarios. The contents of the information set will be determined as the project progresses. It will not be feasible to report all model assumptions and resulting scenario characteristics, because of the quantity of information this would entail and because much of this information is model specific. If appropriate and feasible, additional, more detailed information may be made available by the individual modeling teams.

Page 1, line 44: Change: “scenarios; and (3)”
to read: “scenarios including a careful description of technologies (identify the nature and cost of future technologies and whether these are specific technologies (e.g., hydrogen vehicles) or more generic technologies (e.g., carbon-free technologies available at $x per tonne of GHGs avoided), plus a careful description of what policies the models used to move society from the reference case to the stabilization case; and (3)”

Explanation: Without a careful description of the future technologies and their costs assumed by each modeling group, Synthesis and Assessment Product 2.1 will provide little useful information to the "technology planners" identified on page 1, line 36. Without a characterization of the policies used by the model to achieve a stabilization scenario, no meaningful assessment of the economic implications (page 2, lines 27-28) is possible.

Russell Jones, American Petroleum Institute

Response: The value of providing important technology information underlying the scenarios is noted. The cross-model information set will include information that provides a meaningful characterization of the scenarios. The contents of the information set will be determined as the project progresses. It will not be feasible to report all model assumptions and resulting scenario characteristics, because of the quantity of information this would entail and because much of this information is model specific. If appropriate and feasible, additional, more detailed information, including information on technology assumptions, may be made available by the individual modeling teams.

Page 2, Lines 1-5: It is not acceptable to develop the stabilization scenarios merely in terms of the six greenhouse gases covered by the Kyoto Protocol and to denigrate the importance of "[o]ther gases and radiatively important substances" by saying merely that they "may also be addressed and reported, as appropriate, but may not be used to define stabilization." Given the established importance of sulfate aerosols and the increasingly recognized roles of black carbon and tropospheric ozone, they should be included in the stabilization scenarios as a matter of course.[9] Among other things, it is difficult to understand how realistic radiative forcing could be calculated without taking into account the negative forcing of sulfate aerosols that accompanies the positive forcing resulting from combustion of fossil fuels.[10]

Donald H. Pearlman -- The Climate Council

Response: The four stabilization levels will not address direct or indirect radiative forcing from substances such as aerosols, aerosol precursors, and tropospheric ozone precursors, because of uncertainty in the state of scientific understanding regarding their climatic effects, the importance of regional and short-term detail in looking at these substances, and associated limitations in the ability of many integrated assessment

---

[9] For example, the CCSP notes that "aerosols and tropospheric ozone play unique . . . roles in the atmospheric radiation budget." CCSP, *Vision for the Program and Highlights of the Scientific Strategic Plan*, p. 6 (July 2003). The CCSP's further observation that the roles of these substances currently are poorly quantified does not justify *omitting* them from the stabilization scenarios, because doing so skews the results. The global mean radiative forcing for black carbon is estimated at + 0.2 Wm^{-2} (*TAR-Science*, p. 370) and at + 0.35 Wm^{-2} for tropospheric ozone (*id*., p. 393, Table 6.11), compared to + 0.48 Wm^{-2} for methane and + 0.15 Wm^{-2} for nitrous oxide. *Id.* at Table 6.11. However, current uncertainties in quantifying radiative forcing of these substances may warrant deferring development of stabilization scenarios until we have more confidence in characterization of their roles, rather than developing stabilization scenarios without consideration of these substances.

[10] The estimated direct forcing (1750-2000) of CO_2 is + 1.46 Wm^{-2}, compared to - 0.40 Wm^{-2} for the direct effect of sulfate aerosols, *TAR-Science*, p. 393, Table 6.11, and a range of - 0.3 to -1.8 Wm^{-2} for the "first" indirect effect. *Id.* at p. 375.

models to represent their emissions and climatic effects with a sufficient level of integrity and sophistication. With respect to interpreting the scenarios, the impacts of these other substances can be considered an additional uncertainty in translating to metrics such as total radiative forcing (including such substances as aerosols) or temperature change.

Page 2, line 5: Change: "stabilization."
To read: "stabilization. However, if other gases or factors with potential climate change implications are included in the model, they should be reported, including their radiative forcing."

Explanation: The science is quite clear that factors other than the six "Kyoto gases" specified in the CCSP Prospectus may be impacting climate. To the extent that a model contains such factors (e.g., soot or black carbon, land use change, sulfate aerosols), this information should be documented for possible future use, perhaps even within the Climate Change Science Program. If the policies or technologies that alter the radiative forcing of the Kyoto gas concentrations also simultaneously alter other factors impacting climate in the models, it is critical that these model-simulated impacts be noted and analyzed. To have this entire exercise be Kyoto-gas-centric would be a waste of taxpayers money.
Russell Jones, American Petroleum Institute

Response: The prospectus has clarified the treatment of substances not included in the four alternative radiative forcing levels. The cross-model information set will focus on those gases considered in the radiative forcing stabilization levels: CO_2, CH_4, N_2O, CFCs, HFCs, and SF_6. Other radiatively-important substances (e.g., aerosols, aerosol precursors, tropospheric ozone precursors) are not considered consistently across participating models and will therefore not be included in the cross-model information set. To the extent that participating models have the capability to represent changes in the emissions of other radiatively-important substances with a sufficient level of sophistication and integrity, this information may be made available by the individual modeling teams.

Page 2, Lines 7-11: It is neither acceptable to develop only four stabilization levels nor to leave without further guidance "precise specification of these levels . . . [to] emerge through the scenario development process." Assuming for the sake of argument that we *currently* should have confidence in the CCSP's ability to construct stabilization scenarios "so that the CO_2 concentrations resulting from stabilization are roughly consistent with the range of commonly discussed CO_2-concentration stabilization levels," the chosen stabilization levels, expressed in radiative forcing, should correspond roughly to 450 ppm, 550 ppm, 650 ppm, 750 ppm, and 1000 ppm of CO_2 concentration. After debate as to the range to be assessed, those are the CO_2 concentration levels the IPCC agreed to examine in its Third Assessment Report, *TAR-Science*, p. 223, Figure 3.13; and p. 224. There is *no* justification for the Draft Prospectus (p. 2, lines 9-10) to identify "450 ppm through 750 ppm" as "the range of commonly discussed CO_2-concentration levels." In addition to increasing the number of stabilization levels from four to five to accommodate 1000 ppm, it is essential to specify in advance the spacing of stabilization

levels, as expressed in ppm of CO_2 concentration. That is a policy, not a scientific decision, and it is necessary to avoid skewing the analysis by modelers' later clustering stabilization levels around targets they choose, *e.g.*, 450, 500, 550, 600, and 750 ppm.
Donald H. Pearlman -- The Climate Council

Response: (1) The prospectus has been modified to make clear the four stabilization levels will be designed so that the resulting CO_2 concentrations approximately track the four levels of 450 ppmv, 550 ppmv, 650 ppmv, and 750 ppmv.

(2) The prospectus no longer includes language indicating that these represent "commonly-discussed" levels.

(3) 1000 ppmv is not included in the set of stabilization levels because, given the existing body of scenarios to date, stabilization at 1000 ppmv would probably not represent a meaningful deviation from the reference cases over the period that will be considered in this study.

Page 2, line 10: Because changes in climate are already causing significant environmental impacts, including apparently accelerating the deterioration of the Greenland and West Antarctic ice sheets, even 450 ppm may be too high for ultimate stabilization, exceeding a threshold that would cause inundation of significant areas around the world and in the US, an analysis should also be done indicating what pathway would be needed to return the atmospheric CO_2 concentration to a level of 350 ppm and to stabilize at this level, or at least at this level considering the combined effects of all of the various greenhouse gases. Such a level is also important to consider because the reduction in sulfate aerosol loading will be very likely to be inducing a warming influence that will need to be countered by having lower atmospheric concentrations of greenhouse gases than are often considered. Thus, a scenario should be considered that recognizes that we may need to return to levels lower than the current concentration.
MacCracken, Climate Institute

Response: *The 350 ppmv case is not included in the CCSP scenarios because the associated emissions trajectories would be so stringent as to require actions outside of the range of those responses that are currently represented in the integrated assessment models.*

Page 2, Lines 15-16: It is essential to retain the decision that "likelihoods will not be assigned to the scenarios."
Donald H. Pearlman -- The Climate Council

Response: The comment is noted.

Page 2, Line 20: In order to enable consideration of the range of commonly discussed CO_2 stabilization levels, roughly corresponding to 450 ppm, 550 ppm, 650 ppm, 750 ppm, and 1000 ppm, it is necessary to refer to "five," not "four," stabilization levels.

Donald H. Pearlman -- The Climate Council

Response: 1000 ppmv is not considered as a stabilization goal because, given the existing body of scenarios to date, stabilization at 1000 ppmv would probably not represent a meaningful deviation from the reference cases over the period that will be considered in this study.

Page 2, line 21: After: "…over time?":
Add: "What are the key factors within the model that drives emissions to a certain trajectory in a stabilization scenario?"

Explanation: There are an extremely large number of trajectories that could connect starting point GHG concentrations with a stabilization target. Is the trajectory choice external to the model or selected within the model? What guides that choice (is it a least cost path, is it pretty, is it dependent on assumed technology cost and availability, or what)?
Russell Jones, American Petroleum Institute

Response: The question has been added to the prospectus.

Page 2, line 21-22: Add new "dot item" between lines 21 and 22:
To read: "> *Technology Availability and Cost:* What are the cost and GHG emission rates of assumed future technologies in the model and how does an emission trajectory change as key assumptions regarding cost or emission rates change?"

Explanation: The combination of assumptions on technology availability and cost, plus assumptions on population and economic growth, drive emission projections of the six Kyoto gases. It would be extremely useful for the "technology planners" (page 1, line 36) to know if future emission trajectories are highly sensitive to technology emission rate or cost assumptions buried within integrated assessment models. If the future costs or emission rates of a few key future technologies are lowered 25% and the resulting costs of achieving a stabilization target are then dramatically lowered, technologies planners need to know that information. Sensitivity case information like this can help identify the relative benefits of R&D investments in targeting improvements in different technologies.
Russell Jones, American Petroleum Institute

Response: A primary objective of the CCSP scenarios is to serve as a possible point of departure for further analyses such as technology sensitivity analysis described in the comment above. However, such sensitivity analyses are beyond the scope of this product. The value of providing important technology information underlying the scenarios is noted. The cross-model information set will include information that provides a meaningful characterization of the scenarios. The contents of the information set will be determined as the project progresses. It will not be feasible to report all model assumptions and resulting scenario characteristics, because of the quantity of information this would entail and because much of this information is model specific. If

appropriate and feasible, additional, more detailed information may be made available by the individual modeling teams.

Page 2, Lines 23-24: Delete the sentence inquiring whether "convergence toward a single, or a small set of, dominant technologies or fuels [is] consistent with stabilization at the four [sic.] alternative levels." One of the major reasons why the speculative nature of *emissions scenarios* increases over their typical 100-year time horizon is because we are not able to see clearly (or, actually, at all) how technologies will be developed and penetrate global societies during the course of a century. See, *e.g.,* IPCC Working Group III, *Climate Change 1994: Radiative Forcing of Climate Change and An Evaluation of the IPCC IS92 Emission Scenarios*, p. 242 (1995)("Confidence in scenario outputs decreases substantially as the time horizon increases, because the basis for the underlying assumptions becomes increasingly speculative. Considerable uncertainties surround the evolution of the types and levels of human activities," including "technological advances.") The speculation is exacerbated with stabilization scenarios that, for example, extend over a time horizon of 300 years. See *TAR-Science*, p. 223, Figure 3.13, where stabilization scenarios extend to 2300. Given our experience that huge numbers of technologies we take for granted today were not dreamed of a century ago (or even relatively few years ago in the case of nanotechnologies), it is the height of foolishness to speculate about a limited number of dominant technologies relevant to stabilization. Furthermore, this government-developed set of stabilization scenarios must refrain from even appearing to "pick winners and losers" among future energy or other technologies.
Donald H. Pearlman -- The Climate Council

Response: The prospectus has been modified appropriately.

Page 2, Line 27: Insert immediately after the paragraph concerning "Energy Systems" --

- *"Land Use and Land Use Change:* What contributions from land use and land-use change are consistent with each of the alternative stabilization levels?"

The stabilization scenarios "will address land use and land use change as both GHG sources and sinks." (Draft Prospectus, p. 6, lines 13-14.) This is important, since "[a]pproximately three-quarters of present-day anthropogenic CO_2 emissions are due to fossil fuel combustion (plus a small amount from cement production); land-use change accounts for the rest," CCSP, *Strategic Plan for the U.S. Climate Change Science Program,* p. 71 (October 2003), and forestry sinks are expected to play a significant role in mitigation strategies. In these circumstances, we should seek from the stabilization scenarios insights as to how different strategies concerning land use and land-use change might help achieve alternative stabilization scenarios, just as the Draft Prospectus proposes will be done for "energy systems."
Donald H. Pearlman -- The Climate Council

Response: Assumptions regarding land use and land use change as both GHG sources and sinks will be presented and discussed in the final report. Because models have varying capabilities to explicitly consider land use and land use change, however, such consideration will vary across models.

Page 2, Lines 27-28: In order to enable consideration of the range of commonly discussed CO_2 stabilization levels, roughly corresponding to 450 ppm, 550 ppm, 650 ppm, 750 ppm, and 1000 ppm, it is necessary to refer to "five," not "four," stabilization levels.
Donald H. Pearlman -- The Climate Council

Response: 1000 ppmv is not considered as a stabilization goal because, given the existing body of scenarios to date, stabilization at 1000 ppmv would probably not represent a meaningful deviation from the reference cases over the period that will be considered in this study.

Page 2, line 28: Change: "levels?"
To read: "levels? Carefully specify the policies used in the model to put global emissions on a trajectory to a stabilization level, the emission changes in each country/region in the model, and the economic impacts in those countries/regions."

Explanation: One has to assume that new policies alter the choices that lead to the reference case emissions path. Without knowing what policies modeling groups assumed would force the global economy on to a trajectory to a targeted stabilization level, one cannot assess the economic implications of those policies or the stabilization level.
Russell Jones, American Petroleum Institute

Response: The approach to climate policies in the reference case and the stabilization cases is now explicitly discussed in the prospectus. All scenarios and associated reference cases will include the continuation the United States' greenhouse gas intensity goal through 2012 and the first commitment period of the Kyoto Protocol, which also ends in 2012. In the stabilization scenarios, these near-term policies will be followed by a notional policy, in which all nations of the world participate in emissions reductions and the marginal costs of emissions reductions are equalized across countries and regions.

Page 2, Line 31: Part B: Review of Integrated Scenario Development and Application
The review proposed in this part of the prospectus has the potential to be a valuable addition to our understanding of the scenario process. In particular, we hope that the review will carefully examine the criticisms that have been leveled against the SRES scenarios. An analysis of these criticisms would serve three purposes:

1. It would provide information U.S. policymakers need to judge the validity of studies based on SRES scenarios.
2. It would allow the U.S. to make a valuable contribution to the assessment of the SRES scenarios that IPCC has promised will be part of its Fourth Assessment Report.
3. It would be critical input to the design of the next round of IPCC scenarios, an exercise that has already begun.

References

Castles, I and D. Henderson, 2003: A swag of documents. http://www.lavoisier.com.au/papers/articles/IPPCissues.html.
Dooley, 2001: The Need for a Biotechnology Revolution Focused on Energy and Climate Change. PNNL Report 13551. www.globalchange.umd.edu/publications/PNNL-SA-13551.pdf.
Henderson, D., 2004. Are the IPCC's Global Warming Forecasts based on Faulty Economics? George Marshall Institute, http://www.marshall.org/article.php?id=275.
Hoffert, M.I., et al, 1998: Energy implications of future stabilization of atmospheric CO_2 content. *Nature*, **375**:881-4.
IPCC (Intergovernmental Panel on Climate Change), 1996: Climate Change 1995: The Science of Climate Change. Cambridge University Press, Pg 25-26.
Wigley, T.M.L., R. Richels and J.A. Edmonds, 1996: Economic and environmental choices in the stabilization of atmospheric CO_2 concentrations. *Nature*, **379**, 240-243.

O'Keefe, Marshall Institute

Response: A detailed examination of the SRES process and scenarios, including a review of these controversies, will be included in Part B.

Page 2, line 45: Change: "efforts. The…"
To read: "efforts. Part B will also assess the strengths and weaknesses of developing emission stabilization scenarios that focus only on the six Kyoto gases, given evolving scientific developments indicating other human actions may also be impacting climate. This review should offer suggestions on human factors that need to be better addressed in scenario development. The…"

Explanation: There is a growing literature indicating factors such as land use change, irrigation, black carbon (soot), sulfate aerosols, jet contrails, and other factors, not to mention non-anthropogenic factors such as possible natural climate variability, may be impacting climate. The Part B Review of Integrated Scenario Development and Application should provide suggestions on how to advance scenario development by expanding beyond the six Kyoto gases.

Russell Jones, American Petroleum Institute

Response: Part B will consider various issues related to the breadth of scenarios – including expanding the number of simultaneous environmental perturbations considered, as suggested here, and also questions of elaborating more detailed socio-economic scenarios for purposes of assessing impacts.

Page 3, Lines 9-13: The paragraph on "Applications" is written broadly and, therefore, is likely to invite all sorts of "decisions or conditions" for which scenarios might be "constructed to illuminate." In order to make clear from the outset that the CCSP is committed to objectivity and the avoidance of bias, and that none of its products should be construed as advocating policy positions, a statement along the following lines (adapted from Energy Information Administration, *Annual Energy Outlook 2005*, p. ii) should be added to the paragraph:

"CCSP emissions and related scenarios are based on Federal, State, and local laws and regulations in effect on or before [cut-off date for assumptions underlying scenarios], and, in the case of emissions of other countries, their legally binding obligations under applicable treaties in force as to them on such date. The potential impacts of pending or proposed legislation, regulations, and standards (and sections of existing legislation requiring funds that have not been appropriated) are not reflected in the scenarios."

Donald H. Pearlman -- The Climate Council

Response: CCSP agrees that it is essential that CCSP products avoid both bias and the appearance of bias, and in particular that scenarios should not embed any advocacy of particular policy positions. Because Part B will not be producing scenarios, however, the risk of scenarios implicitly advocating policy positions will not arise in this work. Part B will, however, examine various issues related to the nature of assumptions about future conditions that may be embedded in particular scenarios, the difficulty of clearly distinguishing "intervention" from "non-intervention" scenarios, and the importance of making assumptions underlying scenarios and the process used to generate them as transparent as possible.

Page 3, lines 9-13: An additional question should be added: How sensitive are the results of climate models to differences and uncertainties in the climate scenarios? This question is important to address in order to have context for evaluating the degree of importance to assign to the uncertainties that derive from construction of the scenarios.

MacCracken, Climate Institute

Response: The report will consider issues related to the sensitivity of subsequent analyses to scenario-based uncertainty.

Page 3, line 15: Change: "uncertainties? How…"
To read: "uncertainties? How can the implications of evolving technologies and the potential costs of those technologies be better evaluated in scenario development? How…"

Explanation: It is likely that highly uncertain assumptions on future technologies and their costs play a key role in emission trajectories. The authors developing CCSP Product 2.1 should be challenged to better understand the role of technology and cost assumptions in scenario assessment.

Russell Jones, American Petroleum Institute

Response: The report will consider issues related to the assumptions about technology embedded in scenarios and their implications for subsequent analyses.

Page 3, Lines 18-19: Delete the sentence asking whether existing scenarios, taken as a set, span the range "necessary to encompass" uncertainty about potential future conditions. At least insofar as emissions, stabilization, and climate scenarios are concerned, they should reflect expert judgments as to a range of plausible (in the sense of

worthy of belief) assumptions about the future, which are internally consistent, but excluding assumptions about legislation, regulations, and standards not in effect. Lacking clairvoyance, we cannot possibly know what scenarios are "*necessary* to encompass uncertainty."
Donald H. Pearlman -- The Climate Council

Response: The prospectus has been modified to read, "How might the distribution of existing scenarios be characterized probabilistically, and what are the implications of defining the thresholds of "plausibility," which normally determine the outer bounds of scenarios considered, in different ways?"

Page 4, lines 26-39: It is not clear from this list which author is representing the MERGE model on the team. [And a minor correction: the proper affiliation of Dr. Richels is EPRI as the name was changed some time ago from Electric Power Research Institute.]
MacCracken, Climate Institute

Response: Richard Richels will represent MERGE. The change in the name of EPRI is noted.

Page 57 **(5**), lines 24-31: Section 4 on "**Stakeholder Interactions**" provides for "stakeholder input" for both Parts on the "draft final reports" during the "public comment period" and states that the input could be enhanced by direct requests for "input" during that period by what appears to be a separate "set of stakeholders identified" by the Department of Energy (DOE), as the "Lead Agency" and the "supporting" federal agencies. As we understand this portion of the draft, this input, while occurring during the public comment periods, appears to be separate from the public comment periods. Our perusal of the other two draft prospectuses does not indicate a similar, separate approach to stakeholder input. We question why the DOE and other agencies feel it necessary to contact a range of stakeholders for input outside the public comment period and strongly urge that such separate effort be avoided. Moreover, such an approach may run counter to the requirements and policies of the Federal Advisory Committee Act.
Edison Electric, Holdsworth and Fang

Response: The prospectus has been modified appropriately. No separate process outside of the formal review process will take place. The review process for this product will include a peer review and a public comment period.

Page 5, Lines 26-31: It is not clear what is comprehended by "direct requests for ["enhanced"] input, during the public comment periods, from a set of stakeholders identified by the lead and supporting agencies." Nor is it clear what stakeholders will be invited to participate in the "scenario-relevant conferences, meetings, or other forums, at which the authors will solicit feedback, both formally and informally." There is an implication that the aforesaid stakeholders are a special group that is not coextensive with the broad list of stakeholders originally invited to submit comments on the Draft Prospectus during the February 2 - March 7 public comment period. Exceptional care must be taken to assure genuinely fair and balanced representation among stakeholders

who are granted what appears to be the special privilege of providing what is called "enhanced" input (Draft Prospectus, p. 5, line 28). Aside from being sure this two-tier input system does not create unintended FACA problems, the CCSP must be sensitive to perceptions of bias in the *process* for constructing scenarios that often are highly relevant to the contentious debates over climate change policies.
Donald H. Pearlman -- The Climate Council

Response: The prospectus has been modified appropriately. No separate process outside of the formal review process will take place. The review process for this product will include a peer review and a public comment period.

Page 5, Line 41: In order to enable consideration of the range of commonly discussed CO_2 stabilization levels, roughly corresponding to 450 ppm, 550 ppm, 650 ppm, 750 ppm, and 1000 ppm, it is necessary to refer to "five," not "four," stabilization levels.
Donald H. Pearlman -- The Climate Council

Response: 1000 ppmv is not considered as a stabilization goal because, given the existing body of scenarios to date, stabilization at 1000 ppmv would probably not represent a meaningful deviation from the reference cases over the period that will be considered in this study.

Page 5, line 41: Change: "scenario set will include four…"
To read: "scenario set will include a clearly specified reference case and four…."

Explanation: Assessing the "economic implications" (page 2, line 27-28) cannot be done unless the reference case is carefully specified. As drafted, the Prospectus does not request any information on reference cases.
Russell Jones, American Petroleum Institute

Response: The prospectus has been modified appropriately.

Page 5, Lines 43-44: Presumably, each of the three identified modeling groups is well qualified to make judgments about "plausible and meaningful values for critical drivers." However, the examples of these "critical drivers" listed in the Draft Prospectus are quite limited, which suggests that the modeling groups have discretion as to whether to make assumptions on important emissions drivers not listed, such as demographic factors in addition to population growth (*e.g.*, urbanization; effects of age on labor force and energy use; household size), economic structures in addition to economic growth, and some of the factors that differentiated the IPCC's SRES storylines and scenario families (*e.g,* income-per-capita convergence among regions and increased cultural and social interactions versus a more heterogeneous world). See Nakicenovic, et al., *Special Report on Emissions Scenarios*, pp. 4-5 (2000). The CCSP should include in the final Prospectus a more complete list of "critical drivers" to assure that all three modeling groups will take them into account.
Donald H. Pearlman -- The Climate Council

Response: The prospectus has been modified to make clear that model assumptions will be under the purview of the individual modeling teams.

Page 5, Lines 44-45 and Page 6, lines 3-6: The prospectus stipulates that each group will produce and document "at least one scenario set." This means that each group may only produce one scenario set. In addition, the prospectus states only that "some standardized elements" will be coordinated, but only gives two examples: alternative stabilization levels and GHGs. It explicitly states that some aspects will not be coordinated (population growth, tech change, economic growth). It further states that "differing assumptions among the models provide useful additional hypotheses about the future." No doubt this last statement is true in some cases, but the minimum requirements above are insufficient to ensure this goal. In the familiar simple example, model X makes important assumptions 1A and 2A (about, say technological change and economic growth), and model Y makes assumptions 1B and 2B. If X and Y are the only models, we learn nothing new about assumptions 1 and 2 based on their different outputs. It is entirely possible, therefore, that given the stipulated workload, the models will run entirely different scenario sets. All we learn then is a range of modeled possibility, and not much about the role of technological change or population growth. Identifying one or two additional "suggested scenario assumption areas" like tech change would enable teams with additional interest to focus in on some of the more controversial topics, and therefore make intercomparison more enlightening. In fact, one of the advantages to an exercise like Product 2.1 is that there is an unusual ability to organize such intercomparisons more easily.
Nathan Hultman, Georgetown University

Response: Coordinated sensitivity analyses such as those above intended for model intercomparison and to understand the implications of various important assumptions about the future would be a valuable extension to this product. However, the scenarios in Product 2.1 are designed explicitly to allow the participating teams to exercise their expert judgment independently so as to develop independent alternative examples of stabilization. Hence, it is critical that assumptions not be coordinated across models.

Page 5, Line 45: The stabilization scenarios properly are required to "be constructed to represent meaningful and plausible futures that would be useful to decisionmakers and analysts." (Draft Prospectus, p. 5, line 43). To assure this objective is met, insert at the end of the paragraph at the bottom of page 5: "The documentation for each scenario set shall disclose not only the quantitative assumptions regarding the major driving forces affecting the scenarios, but the reasons (including citation to references relied on) for selecting them over alternative assumptions."
Donald H. Pearlman -- The Climate Council

Response: The need to provide information that will effectively describe the scenarios is noted. The cross-model information set will include information that provides a meaningful characterization of the scenarios. The contents of the information set will be determined as the project progresses. It will not be feasible to report all model assumptions and resulting scenario characteristics, because of the quantity of

information this would entail and because much of this information is model specific. If appropriate and feasible, additional, more detailed information may be made available by the individual modeling teams.

Page 6, line 4: Change: "will not be standardized across modeling teams."
To read: "will not be standardized across modeling teams, except that modeling teams will endeavor to start their simulations from a common historic reference point (date, population, GDP, etc)."

Explanation: As noted in the Prospectus, differing assumptions among the modeling teams may provide useful additional hypotheses about the future. However, it also would be useful if the modeling teams have a common starting point to facilitate evaluation of trajectories, policies and implications.
Russell Jones, American Petroleum Institute

Response: The prospectus has been modified to make clear that model assumptions will be under the purview of the individual modeling teams. This includes assumptions regarding parameters in the year 2000. Along many dimensions, the models will undoubtedly use highly similar assumptions for the year 2000. Along some dimensions, however, uncertainty in 2000 values may be high enough to cause noticeable differences in year 2000 assumptions.

Page 6, Lines 8-11: The prospectus states that each group will document and summarize its own results. However, there is no mention here about explicit intercomparison of the models for the final report. I would suggest including text similar to "The final report should include a discussion of the differences between model assumptions and how the models differed in their results. It should also, to the extent possible, describe what we can learn about which assumptions seem to be most significant in influencing model outcomes." I believe that this language would encourage more clarity in the interpretation of results, and would have the obvious effect of identifying which assumption uncertainties seem to be the most important to reduce.
Nathan Hultman, Georgetown University

Response: The final report will discuss the role of key drivers and assumptions and will compare results, assumptions, and methodologies across models.

Page 6, line 14: Change: "and sinks. Because…"
To read: "and sinks, as well as other human factors possibly affecting climate that are included in the models. Because…"

Explanation: There appears to be somewhat of an inconsistency between Part A (page 2, lines 1-4) and Part B (page 6, lines 13-14) in that the former clearly limits stabilization to the six Kyoto gases while the latter clearly includes land use and land use change. Additionally, to the extent that one or more of the models include other factors, such as soot (black carbon), sulfate aerosols, etc, those factors should be explicitly included in the assessment in Part B.

Russell Jones, American Petroleum Institute

Response: Part A and Part B differ in that Part A is a specific instance of a scenario analysis and Part B is considering a breadth of scenario processes associated with climate change. Hence, Part B will consider a wider range of issues than Part A, potentially including the need for and development of scenarios of emissions of other substances such as soot (black carbon), sulfate aerosols, etc.

Page 6, lines 29-39: The CCSP's Guidelines for Producing CCSP Synthesis and Assessment Products are set up in such a way that these government-appointed panels are, in my opinion, serving in an advisory manner by preparing a report that is reviewed and revised before being submitted to the CCSP, at that point being their best advisory effort. Their report on the government-selected topic is then revised and finalized by government officials, there being no indication that the authors have the final word, and is issued as an official CCSP report under the FDQA guidelines. When First Lady Hillary Clinton took what seems to be a similar approach of involving non-government experts in the preparation of what was to become an official government proposal for modifying the US health care system, the courts ruled that she was in violation of the Federal Advisory Committee Act (FACA). FACA lays out a set of requirements for when government representatives are convening experts to for advice regarding a government position on a matter (see, for example, http://www.fda.gov/opacom/laws/fedadvca.htm). It would seem essential that the organizers of this effort carefully clear this prospectus with appropriate legal counsel, taking into consideration the requirements of the FACA. Of particular concern in determining whether FACA requirements should be applied, such a review should evaluate the provisions that agency representatives are making and controlling the appointments of the authors and that the agency representatives are controlling the final review and publication process.
MacCracken, Climate Institute

Response: The prospectus has been reviewed and modified to address FACA concerns. The prospectus now states that a FACA committee will be formed to review the final report and responses to peer-review and public comments before these are sent forward to CCSP interagency committee and the National Science and Technology Council (NSTC) for final approval and then dissemination.

Page 7, Lines 21-34: Aside from the fact that the scheduled date for posting the final Prospectus on the CCSP web site already has slipped, there are five main issues that make questionable the proposed August 2006 schedule for publication of the stabilization scenarios. Four of these issues, elaborated in the First General Comment of this reviewer, raise concern as to whether there would be added value from stabilization scenarios developed by that date, and they may be summarized as follows:

- Have there been sufficient scientific advances in overcoming the IPCC's assessments of the uncertainties in converting emissions to concentrations?

- Have there been sufficient scientific advances in overcoming the IPCC's assessments of the uncertainties in converting concentrations to radiative forcing?

- Development of multi-gas stabilization scenarios expressed in terms of radiative forcing require further consideration of the serious methodological issues concerning use of Global Warming Potentials (GWPs) to estimate the radiative forcing of non-CO_2 gases.

- Given these clusters of uncertainties, it does not make sense to go to the time, trouble, and expense of *actually developing* the stabilization scenarios and *then* disclosing the treatment of these uncertainties in, and inviting public comments on, the draft scenarios, which have been produced regardless of the uncertainties, rather than issuing a revised Draft Prospectus that specifically invites comments on the three clusters of uncertainties, so that the CCSP can benefit from reviewers' inputs *before* deciding on a schedule for the scenarios' development.

The fifth issue, which calls into question the wisdom of attempting to develop and to publish the stabilization scenarios (Part A) by August 2006, is because the CCSP proposes to complete Part B of this CCSP Synthesis and Assessment Product No. 2.1 at the same time. (Draft Prospectus, p. 7, line 24) Part B will explore "Recommendations," such as: "What improvements can be made to *the process of developing* and using scenarios (e.g., should a broader range of experts and stakeholders be involved in developing scenario assumptions)?" (Draft Prospectus, p. 3, lines 26-28 – emphasis added). The objective of Part B is laudable. With effort and a genuine will to seek improvements to the past and present processes by which scenarios have been developed (notably by the IPCC), the final Part B report can be an important contribution to both climate-change science and policymaking. What are the reasons why the Recommendations and associated information from the Part B report should not *precede* the CCSP's *efforts to develop* the stabilization scenarios? The Draft Prospectus does not contain any information that justifies developing the stabilization scenarios *before* the CCSP can "take a step back" and promulgate the criteria and the processes for developing the stabilization scenarios in light of its and reviewers' consideration of Part B.
Donald H. Pearlman -- The Climate Council

Response: (1) There are multiple uncertainties in scenario generation, including those mentioned above. The CCSP believes that this product will be useful regardless of the uncertainties. A primary purpose of scenarios is to facilitate understanding in situations of uncertainty.

(2) Generating scenarios is not a once-and-for-all activity, but must be repeatedly iterated and updated as knowledge advances and conditions change. Consequently, Part A can contribute to advanced understanding of emission trends and associated economic and technological issues without needing to await completion of Part B.